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TECHNICAL NOTE

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HABITAT MANAGEMENT SERIES FOR UNIQUE OR ENDANGERED SPECIES

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Report No. 13

Ferruginous Hawk
Buteo regalis

FOREWORD

This Technical Note series on wildlife is designed to provide a literature review and summary of current knowledge pertaining to endangered and other wildlife species occurring on public lands. We in the Bureau of Land Management have recognized the need for basic wildlife information in order to do an effective job in land-use planning. Sound planning must identify the negative aspects as well as the positive benefits of any proposed land management decision or program. It is our hope, too, that this series will also prove useful to others--be they land managers, students, researchers or interested citizens.

Curt Berklund

Director
Bureau of Land Management
Department of the Interior

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Introduction

The objective of this report is to provide BLM personnel with the latest and most up-to-date information on rare or endangered species occurring on the public domain. This will provide a tool for improved understanding of the interrelationships between the species and its environment and encourage an end product of enlightened land management which will fully consider the species' welfare in all management decisions.

1. Species Description

The ferruginous hawk, Buteo regalis, is the largest of the North American Buteo hawks, with a body length of 22-25 inches and a wingspan of up to 5 feet. As with most species of hawks, the female is approximately one third larger than the male, and may attain weights of close to five pounds (Grossman and Hamlet, 1964; Williams and Matteson, 1947; Imler, 1937; Howard and Powers, 1973). The ferruginous hawk may also be called the ferruginous roughleg, squirrel hawk, gopher hawk, rusty hawk, or the California squirrel hawk (Eyre and Paul, 1973; Bent, 1937; May, 1935). See Figure 1.

The ferruginous hawk chick is first covered with a short white wooly down with a grayish cast. This down is replaced by a longer, thick, pure white down (Bent, 1937; Brown and Amadon, 1968).

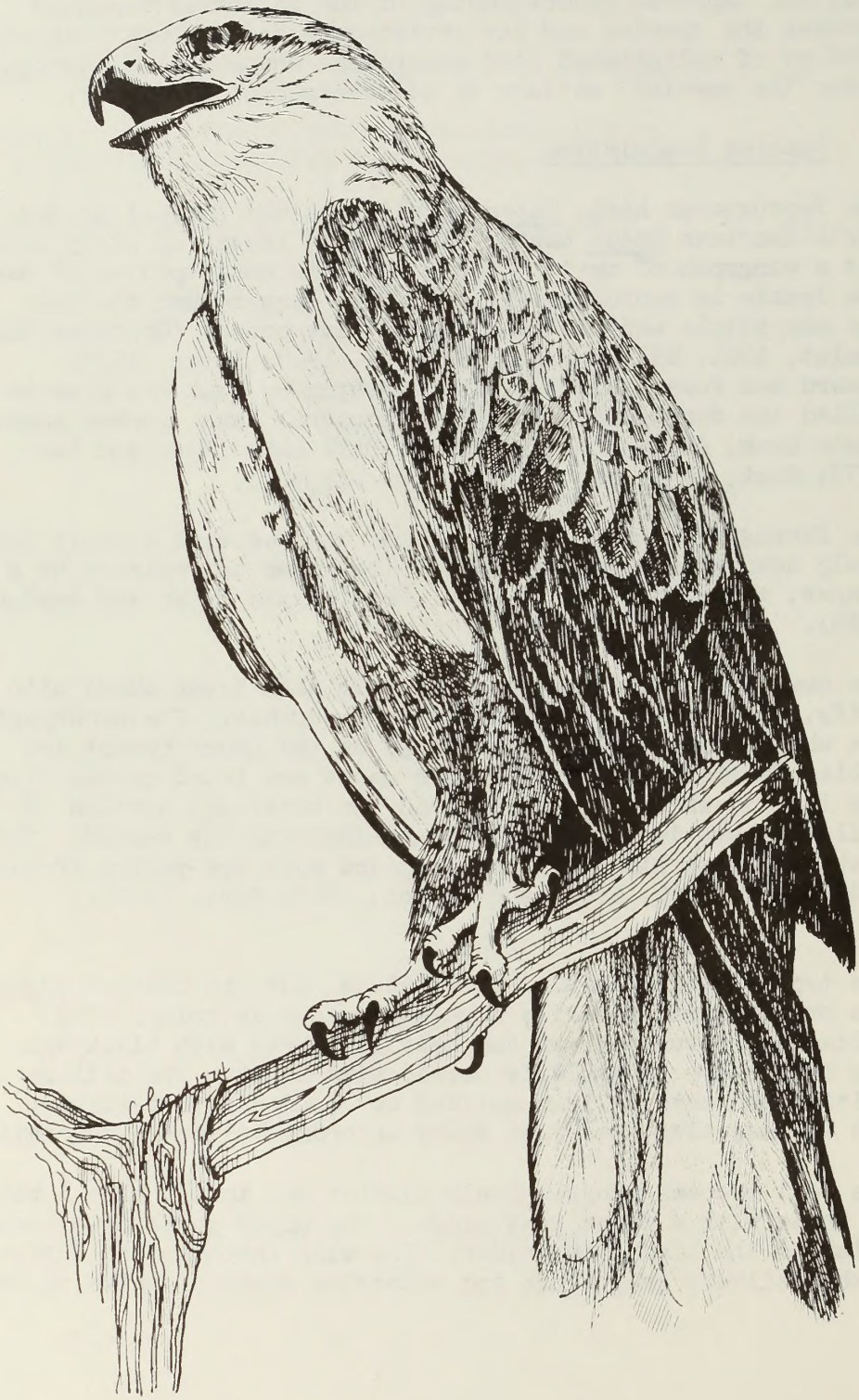
The newly fledged ferruginous hawk is dark brown above with buffy, tawny white or russet feather edgings. The underparts are white, with buffy light orange on the upper breast and tibiae feathers. Large blackish spots are found on the flanks. The tail is white at the base and the remaining portion of the tail feathers is brownish-gray and indistinctly barred. The beak is bluish black and the feet and eyes are yellow (Grossman and Hamlet, 1964; Brown and Amadon, 1968; Bent, 1937).

The typical adult is also brown above, but the feather edgings are broader and primarily cinnamon-rufous in color. The tibiae are a rusty-brown and heavily barred with black and the flanks are irregularly barred with black. The tail is whitish and more or less mottled or clouded with a silvery ash and may also have some tawny or orange-cinnamon coloration.

The tail becomes progressively lighter and in the oldest birds is white with a faint gray tinge. The upper parts also become paler as the bird grows older. The wing feathers are dusky with a silvery grey tinge and extensive areas of white on the

Figure 1

Adult Ferruginous Hawk



inner vanes. The wings, tail and body are white below, except for the tibiae and the tips of the wing quills (Brown and Amadon, 1968; Grossman and Hamlet, 1964; Bent, 1937). The eyes of the adult are brown.

The ferruginous hawk has two color phases, the light phase and the melanistic or dark phase. Plumages described above are for the light phase, which is more common. In the melanistic phase, the entire body is a dark brown, sometimes with rufous feather edging. The wings and tails are the same as in the light phase (Brown and Amadon, 1968; Bent, 1937; Grossman and Hamlet, 1964).

The ferruginous hawk may sometimes be confused with the rough-legged hawk, Buteo lagopus, which exhibits considerable variation in its coloration, also having both light and dark phases. As with the golden eagle (Aquila chrysaetos), the ferruginous hawk and the rough-legged hawk both have fully feathered tarsi. However, the tarsi of the adult light-phase ferruginous hawk form a distinctive dark V which is not observed in rough-legged hawks. This characteristic is also useful for distinguishing ferruginous hawks from light red-tailed hawks, which lack this V. All rough-legged hawks have a broad black tailband, while both color phases of the ferruginous hawk have whitish tails without such a band (Brown and Amadon, 1968; Bent, 1937; Peterson, 1941).

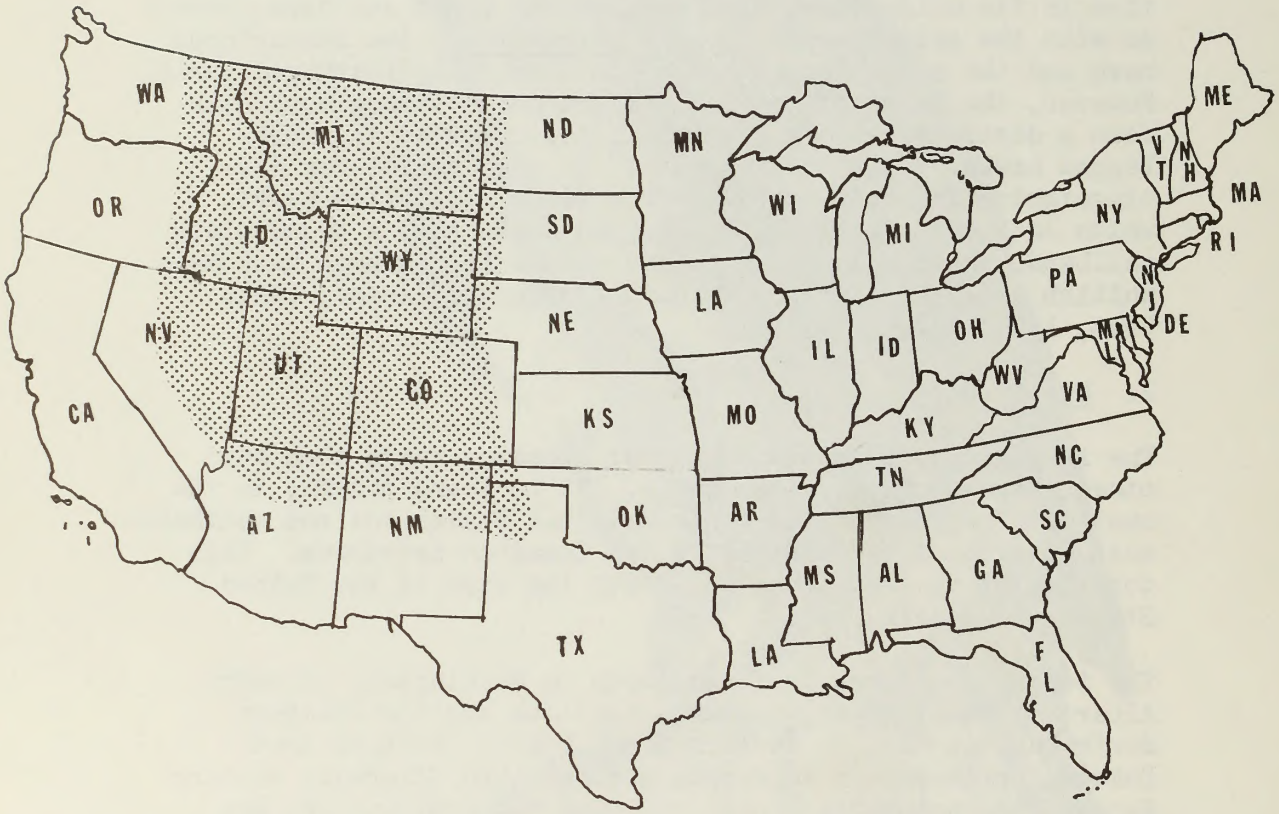
2. Distribution

The ferruginous hawk has a smaller breeding range than any other large North American Buteo. It is found chiefly in the semi-arid regions of the western United States and the southernmost portion of the prairie in the Canadian provinces. This constitutes an area about one-fifth the size of the United States (Olendorff, 1973).

The ferruginous hawk is found north to Washington, southern Alberta, Saskatchewan, southern Manitoba and northeastern North Dakota; east to eastern North Dakota, western South Dakota, northeastern Nebraska, northeastern Colorado, western Kansas, the panhandle region of Texas and southwestern New Mexico; south to southern New Mexico, Arizona and central California; west to California, Oregon and Washington (Bent, 1937). See Distribution Map, Figure 2.

Figure 2

Approximate distribution of the ferruginous hawk
in the United States



3. Status and Population Trends

Overall population estimates for the ferruginous hawk are not available in the literature. Very few studies have been conducted on this species and population data is scarce.

Williams and Matteson (1947) indicated that the ferruginous hawk is a common summer resident in Wyoming and that a few of these hawks may be seen all year round. A recent report (1969) from Oregon State University stated that in 1940, the ferruginous hawk was listed as a common summer resident in eastern Oregon, with 28 nests reported for two counties. In recent years, only four to five nests have been reported and the ferruginous hawk is considered endangered in Oregon.

In 1914 Cameron reported the ferruginous hawk as the most abundant Buteo hawk in Montana. In Washington, ferruginous hawks have been found in limited numbers east of the Cascade Mountains (Bowles and Decker, 1931). In 1930, Davy reported an area near Antler, North Dakota, near the Canadian border, as the only location for breeding ferruginous hawks in that state. Olendorff (1973) has indicated that ferruginous hawks are year-round residents in the Pawnee National Grasslands, northeastern Colorado. Willock (1972) listed the ferruginous hawk as one of the most common hawks in the open grasslands of southern Alberta, Saskatchewan and Manitoba. Nesting ferruginous hawks have been reported in northcentral South Dakota (Lokemoen, personal communication).

Studies conducted in Idaho (Howard and Powers, 1973; Howard, in prep.; Powers, et al) and Utah (Howard and Powers, 1973; Howard, in prep.; Powers, et al; Weston, 1969; Platt, 1971; Smith and Murphy, 1973) indicate that the ferruginous hawk is maintaining its numbers in areas where it is not molested either directly or through loss of habitat, and in favorable circumstances may be the dominant species of raptor nesting in certain areas. Population data is not available in the literature for the remaining western states.

4. Life History

The ferruginous hawk is similar to the golden eagle, as both species have feathered tarsi, similarly marked and shaped eggs, food habits, flight and voice and build large nests (Bent, 1937). Regardless of these similarities, there are distinct differences between the two and the ferruginous hawk cannot simply be classed as a small eagle.

Like the golden eagle, the ferruginous hawk utilizes thermal updrafts for soaring. The most characteristic flight pattern described is that of beating the wings several times, then gliding. A number of different hunting techniques have been observed. A common hunting technique observed in Utah has consisted of low flight a few feet above the ground over open country using rapid wingbeats (Weston, 1969). Soaring is apparently used infrequently when hunting prey (Weston, 1969; Angell, 1969).

Most of the hunting that Angell (1969) observed in Washington was done from a height of 40 to 60 feet above the ground. The hunting adult would beat its wings three or four times, then glide. When prey was sighted, the hawk beat its wings rapidly and glided swiftly towards the ground. The hawk approached at an angle to its prey. An angled path apparently permits interception of the prey and also reduces visibility of the hawk to its quarry (Willock, 1972).

If pursued quarry reaches cover before the hawk can strike, the hawk may land and walk through brush in an attempt to flush its prey. If it succeeds, it will take flight and make another strike (Angell, 1969). Ferruginous hawks have also been observed to hover much in the manner of the kestrel (Falco sparverius). This hovering method is used when ferruginous hawks are hunting pocket gophers. When a pile of damp earth which a gopher has pushed to the surface or movement of such piles is noted, the hawk will land and watch. When the gopher comes close to the surface, the hawk will rise into the air and strike at the gopher (Bent, 1937; Howard, personal communication; Snow, personal observation).

Cooperative hunting has also been observed, with one adult flying high and the other flying low in pursuit of a jackrabbit (Lepus sp.). The jackrabbit caught sight of one hawk but not the other, which hit with one foot on the rabbit's back and the other around its muzzle. In this instance, the female made the kill and took part of it to the nest to feed her young, while the male sat in a nearby tree (Renn, personal communication; Howard and Powers, 1973). A male and a female ferruginous hawk were both observed to strike a jackrabbit, the female binding to its hindquarters and the male sinking its talons into the head and forequarters (Snow, personal observation).

Nesting ferruginous hawks begin hunting at dawn and often stop by sunrise. They will hunt again at sundown until dark. They have also been observed hunting in late afternoon (Weston, 1969; Smith and Murphy, 1973).

Ferruginous hawks have a less diverse diet than redtailed hawks (Buteo jamaicensis) and Swainson's hawks (Buteo swainsoni). In some areas over 90% of their diet consists of lagomorphs and rodents. In Weston's study (Weston, 1969) in Cedar Valley, Utah, 44% of the total prey consisted of kangaroo rats (Dipodomys ordii); 30% was blacktail jackrabbits (Lepus californicus). In Smith and Murphy's study of the eastern edge of the Great Basin Desert in northcentral Utah, 62.5% of the total prey items consisted of lagomorphs (Smith and Murphy, 1973). Howard (in prep.) has also observed jackrabbits to be a major prey item of ferruginous hawks in northeastern Utah-southeastern Idaho.

In northeastern Colorado, Olendorff (1973) noted that 41% of the prey items he checked were thirteen-lined ground squirrels (Citellus tridecemlineatus). Other species which were at least 5% of the total prey were the northern pocket gopher (Thomomys talpoides), blacktail (Lepus californicus) and whitetail jackrabbits (Lepus townsendi), cottontail rabbits (mainly Sylvilagus audubonii), horned larks (Eremophila alpestris) and meadowlarks (Sturnella neglecta).

Other species which ferruginous hawks are known to have eaten include antelope squirrels (Citellus leucurus), deer mice (Peromyscus maniculatus), pocket mice (Perognathus parvus), rock squirrels (Citellus variegatus), harvest mice (Reithrodontomys megalotis) (Weston, 1969), weasels (Mustela sp.), shorteared owl (Asio flammeus), leopard lizard (Crotaphytus wislizenii), harrier (Circus cyaneus), meadow mice (Microtus sp.) (Platt, 1971), Richardson's ground squirrel (Citellus richardsoni), mountain cottontail rabbit (Sylvilagus nuttalli) (Willock, 1972), prairie dogs (Cynomys sp.) (Cameron, 1914) and horned lizards (Phynosoma platyrhinos) (Powers, 1973).

The importance of a food item in any raptor's diet can be misunderstood if only frequency counts are taken. Smaller prey items may appear with much greater frequency than larger prey species. Only recently have investigators begun to look at raptor diets from the standpoint of biomass consumed. In Smith and Murphy's study in Utah, lagomorphs constituted 62.5% of the total prey in 1969 and 1970, but this was 97.4% of the total prey biomass consumed by ferruginous hawks in those years. Howard (in prep.) has observed similar statistics in his study in northern Utah-southeastern Idaho, indicating that jackrabbits are a far more crucial food item than frequency counts suggest.

The northernmost ferruginous hawks tend to be migratory, wintering somewhat south of the northern extent of the breeding range (Bent, 1937). In an analysis of 114 band returns, Salt (1939) concluded that the migratory route was a comparatively

narrow lane following the Rocky Mountains. The wintering area for ferruginous hawks banded in Alberta, Canada, included New Mexico, Colorado, Kansas, Texas and Oklahoma. Howard and Powers (personal communication) have received a band return from Sonora, Mexico.

In Utah, returning ferruginous hawks have been observed in late February - early March (Weston, 1969; Smith and Murphy, 1973). Because they are year-long residents in northeastern Colorado, it is difficult to determine when they move to their nesting territories, but the earliest nesting activity probably occurs after the first week in March (Olendorff, 1973).

Most nests are probably constructed in March. Weston (1969), Angell (1969) and Smith and Murphy (1973) indicate that both the male and the female bring nesting materials to the nest site, but the female does the actual arranging. Olendorff (1973) has observed that the adults may repair two or three nests before laying eggs in one of them. Olendorff also stated that the nest building period was complex and lengthy. However, Smith and Murphy (1973) stated that nest building took from one to three days on their study area. The hawks they observed were secretive during nest construction and if interrupted frequently began construction of another nest at another site. Twelve newly constructed nests were abandoned, presumably because of the presence of the researchers.

In Smith and Murphy's study area, the adults were quite aggressive while establishing their territories. This aggressive behavior was directed not only towards members of their own species, but other species of raptors as well. Although there was a lot of chasing, no contact was ever observed.

There are no reports of observations of courtship flights. Olendorff (1973) is of the opinion that nest site selection and nest building may be more important. Powers (1973) is presently doing a behavioral study of ferruginous hawks, one of the objectives being attempted observation of courtship behavior.

Egg-laying begins in April, usually after the first week (Bent, 1937; Weston, 1969; Olendorff, 1973; Bowles and Decker, 1931). The number of eggs laid ranges from two to six, with three or four eggs being the most usual number in a clutch (Bowles and Decker, 1931; Olendorff, 1973; Eyre and Paul, 1973; Howard and Powers, 1973; Smith and Murphy, 1973; Bent, 1937; Brown and Amadon, 1968; Rolfe, 1896; Davy, 1930).

The incubation period is variously given as 28 days (Brown and Amadon, 1968; Bent, 1937; Eyre and Paul, 1973), 32 days (Weston, 1969) and 35 days (Olendorff, 1973). The female apparently does most of the incubating, with the male taking over while the female eats (Willock, 1972; Angell, 1969; Howard and Powers, 1973).

Once the young have hatched, the female broods them almost constantly for the first five to seven days. During this time, the male does all the hunting, brooding the young while the female eats. The female feeds them what the male brings in (Howard and Powers, 1973). As the young grow older, both adults spend more time soaring and roosting in areas around the nest (Weston, 1969). They are particularly vigorous in nest defense after the young have hatched (Smith and Murphy, 1973).

The young hawks fledge at the age of 38 to 50 days (Olendorff, 1973; Eyre and Paul, 1973; Howard and Powers, 1973). Howard and Powers have observed that the males tend to leave the nest first and weigh an average of 2½ pounds. The females may leave as much as ten days later, and weigh between 3 and 4 pounds. Newly-fledged hawks remain in the nest vicinity for several weeks (Howard and Powers, 1973; Smith and Murphy, 1973). During this time the parents continue to feed them and defend them (Smith and Murphy, 1973).

As with other species of raptors, the young birds seem to suffer the highest mortality rates. Most of the band returns that Salt (1939) received out of 114 were from birds less than one year old. The ratio was approximately 20 out of every 25. Most of the bands were from hawks which had been shot. Shooting mortality has also been reported by Smith and Murphy (1973), Weston and Ellis (1968), Eyre and Paul (1973), and Howard (in prep.).

Heat prostration is a possible cause of mortality in unfledged birds (Olendorff, 1973). Other causes of mortality reported include strangling after becoming entangled in the nest tree during a storm, death while trying to regurgitate a rabbit's foot, starvation (Platt, 1971), being killed by cars while eating road-killed jackrabbits, and becoming stuck in road tar dumped in gravel pits, dying of shock and starvation (Howard and Powers, 1973).

Although most ferruginous hawks probably do not live longer than a few years in the wild, two exceptional band returns have been obtained. One reported by Hughes in 1937 was from a hawk twenty years old that had been banded in its first year. A return reported by the Western Bird Bander (1973) is of a bird 17 years, 3 months old.

Smith and Murphy (1973) observed that over 10% of the eggs they examined in the Great Basin Desert in Utah were infertile. The most common situation encountered was one in which one of a clutch of 3 or 4 eggs was infertile. In spite of an average clutch size for the years 1967-1970 of 3.23 eggs, fledging success was an average of 2.0 young per nest per year.

Weston (1969) observed an average of 3.57 eggs per nest in Cedar Valley, Utah in 1968. The average number fledged per nest was also two birds. Platt (1971), in a survey of Curlew Valley reported in 1971, observed 3.4 young fledged per nest. Howard (in prep.) noted that an average of 2.1 hawks fledged per active nest in which eggs were deposited in nests in northern Utah - southeastern Idaho during 1972 and 1973. Olendorff (1973) observed that 1.73 young fledged per nest in grasslands habitat, but only 1.33 fledged from nests in creek bottoms on the Pawnee National Grasslands.

The interspecies relationships of ferruginous hawks have been studied in greater detail than for some other species of raptors. Although actual physical contact and combat with other raptorial species is rare, in some situations ferruginous hawks may be the predominant raptor and the dominant Buteo. Smith and Murphy (1973) observed this to be the case in the Great Basin Desert. Ferruginous hawks appeared to displace redtailed hawks and Swainson's hawks and limit the populations of these species in their study area.

Grayson (Adolphson and Jonkel, 1969) reported that ferruginous hawks were displacing redtailed hawks and occupying former redtail territory in the Texas panhandle. In 1914, Cameron reported that the ferruginous hawk was the most abundant raptor in Montana after the kestrel. In 1944, the Swainson's hawk was reported by Behle as the most common hawk of central Utah valleys. Smith and Murphy's study indicates that at least in some parts of Utah, the ferruginous hawk may be displacing the Swainson's hawk.

Olendorff's study in Colorado indicates that there may be a high degree of competition between ferruginous hawks and Swainson's hawks. They use each other's major nesting habitat 30-35% of the time. Over one half of all ferruginous hawk nests located were in unbroken grassland and approximately one third were in creek bottoms. Approximately 63% of the Swainson's hawk nests located were in creek bottoms, and 30% in unbroken grasslands. The ferruginous hawk nests earlier, giving it an advantage in nest site selection, but the greater versatility of the Swainson's hawk in diet and in being able to successfully nest near cultivated lands may offset this advantage.

Smith and Murphy (1973) also noted that the presence and dominance of the ferruginous hawk in their study area is limited by its narrow breeding habitat requirements. In favorable areas, the ferruginous hawk consistently produces larger clutches and fledges more young than any of the other large raptors found there, but they are completely absent from unfavorable habitats, whereas the other raptors appear more adaptable, particularly in using areas influenced by man.

Smith and Murphy feel that ferruginous hawks are dominant on their study area because of the presence of highly suitable habitat which allows maximum expression of their productivity. They expressed the opinion that the large size of the ferruginous hawk may also contribute to this dominance in certain areas.

Ferruginous hawks can be quite aggressive in defending their young from mammalian predators. Both Angell (1969) and Powers (personal communication) have observed adults striking and succeeding in driving off coyotes (Canis latrans).

5. Habitat Requirements

The ferruginous hawk is almost totally restricted to the western plains. On the prairie, it nests in trees along streams. In badlands or treeless areas, it nests on low cliffs, buttes and cutbanks (Bent, 1937; Olendorff, 1973). It also nests on the edges of pinyon-juniper communities (Howard, in prep.; Howard and Powers, 1973; Smith and Murphy, 1973). In some areas, ground nests are quite common (Weston, 1969; Weston and Ellis, 1968; Howard and Powers, 1973; Rolfe, 1896; Jonkel, 1966; Davy, 1930; Ward, 1968; Olendorff, 1973; Williams and Matteson, 1947; Cameron, 1914; Bowles and Decker, 1931).

Ferruginous hawk nests have been found in cedars (Jacot, 1934; Williams and Matteson, 1947), limber pine, willow trees (Williams and Matteson, 1947), cottonwoods (Williams and Matteson, 1947; Olendorff, 1973), sagebrush (Smith and Murphy, 1973) and swamp oaks (Bent, 1937), but the most commonly used tree for nesting appears to be the juniper (Weston, 1969; Howard, in prep.; Howard and Powers, 1973; Smith and Murphy, 1973; Platt, 1971; Jewett, 1926; Bowles and Decker, 1931).

The juniper trees usually chosen by the adults for nesting are frequently isolated and often in the transition zone to the adjacent community (Howard and Powers, 1973; Jewett, 1926; Smith and Murphy, 1973). The nest will be located from six to ten feet above the ground and in some trees is quite conspicuous (Weston, 1969; Howard, personal communication).

Whether it is built in a tree, on the ground, or a butte, nest construction is essentially the same. Nesting material is composed of sticks up to one inch in diameter which are taken from whatever is available in the area around the nesting site. In juniper nests, juniper, shadscale and sagebrush provide most of the materials used in nest building (Weston, 1969). One item frequently found in the nest is one or two pieces of dried cow manure (Howard and Powers, 1973; Weston, 1969; Bowles and Decker, 1931; Cameron, 1914; Jewett, 1926; Olendorff, 1973; Bent, 1937; Rolfe, 1896). The nest cup lining is often composed of shredded tree and shrub bark (Howard and Powers, 1973; Weston, 1969).

Nest diameter may be less than three feet for a ground nest, which may also be less than a foot in depth (Weston, 1969). However, if a ground nest is reused enough times, it may become considerably larger. Along the route travelled by the Donner Party through Utah in 1846, ferruginous hawk ground nests up to six feet high and nine feet in diameter were reported (Howard and Powers, 1973).

Tree nests may be from three feet in diameter and a foot and a half deep to over four feet in diameter and depth (Weston, 1969). A tree nest reported by Jacot (1934) in Arizona was four feet in diameter and over seven feet deep. Indications were that three complete nests had been built, one on top of the other.

Ground nests are built in a variety of situations. If the nest is situated on the summit of a hill, it is enclosed and held in place by boulders. If it is on the side of a hill, a boulder which forms a natural shelf is used as the base of the nest (Rolfe, 1896; Jonkel, 1966; Bowles and Decker, 1931). Ground nests are also placed near the summit of isolated buttes (Cameron, 1914; Williams and Matteson, 1947) and creek banks (Olendorff, 1973; Bent, 1937).

There is some disagreement as to whether or not ferruginous hawks reuse old nests to any degree. Rolfe (1896), on a strip of land 40 miles long and 8 to 15 miles wide, examined 200 old nests and another 25 which had eggs. He felt that old nests were not used again, but new ones were built nearby if the site was suitable.

Smith and Murphy (1973) indicated that the ferruginous hawks in their Utah study area selected a different nesting site 75% of the time, but remained in the same locality for successive years 77% of the time. In 1967, Weston (1969) estimated that 58% of the occupied nests in Cedar Valley, Utah, were newly constructed. In 1968, this figure was 43%.

Bowles and Decker (1931) indicated that ferruginous hawks in Washington usually used old nests and rarely built a new one. Cameron (1914) reported that in Montana the same nest was occupied for a series of years and annually repaired. Olendorff (1973) indicated that several nests might be repaired before one was selected for egglaying. Many ferruginous hawks in southeastern Idaho - northern Utah also use old nests (Powers, 1973).

Preferred habitat for ferruginous hawks in northern Utah - southeastern Idaho appears to be in the sage and crested wheat grass community which contains isolated junipers (Howard, in prep.). Smith and Murphy (1973) found 2/3 of the ferruginous hawks in the Great Basin Desert on low foothills surrounding the valleys and on the fringes of pinyon-juniper woodland, while 1/3 were found in the desert scrub community well beyond the limits of the woodland. Weston (1969) also found the ferruginous hawks in Cedar Valley nested on the low foothills on the perimeter of the valley.

In Washington, Bowles and Decker (1931) found most ferruginous hawks in flat sagebrush country where outcroppings of rock or scattered trees were present. Jewett (1926) found that the same type of habitat was utilized in Oregon.

In Wyoming, most ferruginous hawks are found on the prairies and in badland and butte country (Williams and Matteson, 1947). In Colorado, ferruginous hawks are found in unbroken grasslands and creek bottoms (Olendorff, 1973).

Ferruginous hawks are consistently absent from areas of steep-sided canyons, cliffs or heavily wooded areas, including the interior of pinyon-juniper woodland. These areas do not support large enough populations of lagomorphs to maintain ferruginous hawks (Smith and Murphy, 1973).

Ferruginous hawks are occasionally found nesting in an atypical situation. Nests have been constructed on straw stacks, the straw-covered roof of an abandoned stable, the tops of old chimneys and windmills on deserted farms and power poles (Howard and Powers, 1973; Davy, 1930; Bent, 1937; Lokemoen, personal communication). These are rather vulnerable sites and in the days of egg collecting they were frequently stripped of their eggs by egg collectors who would work an entire area, taking all of the eggs that they found (Davy, 1930; Rolfe, 1896).

6. Limiting Factors

Until recently, the ferruginous hawk has not been studied in any detail. Consequently, there is much information which is yet to be obtained. Studies by Howard, Powers, Smith and Murphy, Platt and Weston indicate that at least in Utah the population is reproductively sound. In comparable areas in Colorado, ferruginous hawks are also producing normal sized clutches (Olendorff, 1973).

One limiting factor which has emerged from these studies is the problem of nest desertion. This apparently has been well known to egg collectors, as Davy in 1930 indicated that nine times out of ten the adults would desert the nests that he checked for egg sets. He further suggested that anyone collecting the eggs might as well take what was in the nest, even if the clutch was incomplete, so certain was he that the adults would not return.

Recent studies by Olendorff (1973), Howard and Powers (1973) and Smith and Murphy (1973) verify this behavior of nesting adults. Some pairs are so secretive that even one visit by researchers or other people within sight of the nest may cause desertion of the nest. The adults will abandon a site while constructing the nest, but most often desertion occurs during incubation. Once the young have hatched, the probability of desertion is very slight.

With the increasing demand on public lands for resource development and recreation, human activity in areas with nesting populations of ferruginous hawks may become a severe limiting factor if such activity occurs during the period before the young hawks have hatched. This will mean a loss of habitat for ferruginous hawks even if the actual land itself is left intact and not altered during development.

Chaining, burning and discing on a massive scale and other alterations of appropriate ferruginous hawk habitat such as desert scrub and juniper communities will also mean a loss of hawks through destruction of nesting sites and prey populations (Howard, personal communication). Since ferruginous hawks may repair two or more nests before choosing one for egg deposition, the absence of numerous potential nesting sites may be a limiting factor (Olendorff, 1973).

Data collected by Howard (in prep.) on ferruginous hawk populations in northern Utah - southeastern Idaho and jackrabbit populations in the same area suggest that the productivity of ferruginous hawks is related to the numbers of jackrabbits

available as prey. In this area, Platt (1971) observed a productivity of 3.4 young fledged per nest during a year when the jackrabbit population was quite high. Jackrabbit density in the spring of 1971 was 61.7 per square mile. By fall this figure had risen to 176 per square mile. In 1972, jackrabbit density was 122.1 per square mile in the spring and declined to 89.3 per square mile in the fall. In 1973, spring jackrabbit density was 25.2 per square mile and fall density was 19.6 per square mile, a precipitous decline of 82% (Dr. Charles Stoddart, Utah State University, personal communication). In 1972-1973, the fledging rate of ferruginous hawks was approximately 2.6 per nest (Howard, personal communication).

Woffindon (personal communication) reports that in 1973 there were very few nesting attempts by ferruginous hawks in Cedar Valley, where Weston (1969) reported over twenty pairs nesting during a time when the jackrabbit population was high. The number of golden eagles nesting this year in Utah and Idaho and the number of young produced was also reduced (Kochert, personal communication; Murphy, personal communication). Both species utilize jackrabbits as the major prey item on a biomass basis, with over 95% biomass accounted for by lagomorphs (Smith and Murphy, 1973; Arnell, 1971).

Olendorff's study (1973) in the Pawnee National Grasslands indicated that man's influence is temporal as well as spatial. When the white man first arrived in this part of Colorado, there were attempts at habitation and cultivation which were abandoned. However, the grasslands were significantly altered in some instances, especially where homesteads were established, a water supply maintained and trees planted. Olendorff theorizes that there may have been a decrease in the ferruginous hawk population at least in this area since the white man arrived, primarily due to destruction of habitat through cultivation. He also feels there may have been a shift from ground to tree nesting.

Twenty-eight of 41 nests which he found in unbroken grassland areas were in man-created situations. Thirty-one percent of the ferruginous hawks utilized trees growing where attempts had been made to manipulate the natural water supply.

However, ferruginous hawks nesting in trees in man-created situations fledged only 1.52 young per attempt, compared to non-tree nesters which fledged 2.15 young per attempt. Although ferruginous hawks nested at abandoned farmsteads, ditches and man-made ponds, they were less successful in fledging young at these sites than at natural nest sites where there was no evidence of previous human habitation.

Thirty-one of 43 nests were in remote or otherwise inconspicuous areas. Clutch size at remote sites averaged 3.23, compared to a clutch size of 2.82 in nests easily accessible to the public. The probability of fledging from a nest in a remote area was 24.5% greater than in publicly accessible areas (Olendorff, 1973).

Although these data indicate that ferruginous hawks are adaptable enough to use man-created situations, for some reason clutch size and fledging success seems to be reduced. Even long past human activity appears to result in lowered productivity.

Reports from egg collectors around the turn of the century (Rolfe, 1896) and up to 1930 (Davy, 1930) indicate that four and five egg sets were common, and six egg sets could be found if one was persistent in his searching. Recent studies by researchers indicate that three and four egg clutches are usually found. It is entirely possible that the scope of man's activity in ferruginous hawk habitat has been far reaching enough that the overall productivity is lowered from what is formerly was. This conclusion is speculative in nature because of the lack of population data for ferruginous hawks prior to recent years.

7. Recommended Species and Habitat Management Techniques

1. Short-term recommendations. Ferruginous hawks appear to be especially sensitive to human activity. They will readily abandon their nests even after a single visit if the young are still unhatched. Land management changes such as juniper chaining, burning, discing and well-drilling can be very detrimental. If such activities are to be carried out in an area where ferruginous hawks are nesting, these activities should be delayed until the young hawks hatch. Where treatments cannot be delayed and young hawks are present in the nest, the young birds may be transferred to another nest with young of the same age. If it is not possible to transfer the young hawks to another ferruginous hawk nest, they may be transferred to a redtailed hawk nest. Where treatment cannot be delayed and eggs are in the nest, that nest will have to be sacrificed. Attempts should not be made to transfer the eggs to another nest because of the great probability of causing the adults to desert (Howard, personal communication).

2. Long-term recommendations. Where treatments such as crested wheatgrass planting, spraying, discing and burning are implemented, a minimum of 15% of the total area should be left in its present stage of succession in the form of islands scattered throughout the treated area. Where juniper communities are chained, an edge effect can be created by thinning trees on the perimeter of the chained area instead of completely removing them. This approach maintains some habitat suitable for possible reproduction. It also allows for the re-establishment of the prey base in the treated areas. Alteration of habitat by chaining, burning or discing can be an effective method of enhancing wildlife habitat. It is important to remember that a number of species are going to be affected by such alterations. A pattern of small tracts of land, creating many ecotone areas, will probably be more beneficial to more species than treating the same area in large tracts. Results of Howard's study have indicated that past crested wheatgrass plantings have not been detrimental to ferruginous hawks in his Utah-Idaho study area as far as the ability of the hawks to reproduce. Succession occurring in these areas has made the area suitable for raptors within a period of six to eight years after the treatment (Howard, personal communication).

3. Any land use practices to be implemented in an area where ferruginous hawks are nesting should be studied for their impact not only on the hawks but on the prey species which sustain them. Studies are needed to determine the prey biomass necessary to support the raptors present in a given area (Howard, personal communication).

4. Since ferruginous hawks will nest in man-created situations, specifically in trees planted along creek bottoms, and since these trees are subjected to destruction by cattle and wind damage, fencing single trees and small groves of trees where these hawks nest may be beneficial. Planting new trees in small fenced enclosures near semi-permanent water sources may also prove beneficial in the future (Olendorff, 1973).

5. Productivity may be increased by limiting or prohibiting human access to within 300 yards of the nests during the incubation period (Olendorff, 1973).

6. Building artificial nesting structures as has been done for ospreys (Pandion haliaetus) in Michigan may be beneficial. Providing shade on these structures may increase the probability of hatching by increasing the humidity level. More eggs hatch in shaded nests than in unshaded nests (Olendorff, 1973).

7. Placing artificial nesting structures and hunting perches in prairie dog towns may attract ferruginous hawks and other species of raptors which will utilize the rodents as a food source and act as some control on prairie dog populations (Olendorff, 1973).

8. Protective Measures Instituted

a. Legal or regulatory

The ferruginous hawk is protected by the treaty signed with Mexico in March of 1972 and is protected by state law in the states in which it is found.

b. Captive rearing

A private individual living in one of the Pacific Coast states has a pair of ferruginous hawks which have bred in captivity. The name of this person is not available, nor will he release any information as to probable reasons for this captive breeding.

c. Habitat protection and improvement

1. The Bureau of Land Management in Utah has erected nesting/feeding platforms in the Salt Lake District. Each platform has been placed on a low hill or ridge in a broad valley which appears to be a good observation point for birds of prey. Although the platforms are in good nesting areas for ferruginous hawks and golden eagles, these areas are also used as sheep bedding grounds and by motorcyclists (W. G. Leavell, Associate State Director, BLM, Utah).

2. BLM personnel in Colorado have been working closely with the electrical power companies to insure that the installation of powerlines will not electrocute any raptors which may use power poles as perches. Two raptor perches were installed on national resource lands west of Saguache, Colorado. These perches are constructed of 20-foot-long poles, 8

inches in diameter with a 3-foot crossarm at the top. The perches are located in large active prairie dog towns in a large flat area with no other elevated perches available within several miles. To date these perches have been used by ferruginous hawks, redtailed hawks, march hawks (Circus cyaneus) and golden eagles (D. R. Andrus, State Director, BLM, Colorado).

d. Reintroduction

There are no known attempts of reintroduction of ferruginous hawks in the United States.

9. Ongoing Research Projects

1. Richard Howard at Utah State University has been studying the breeding biology of the ferruginous hawk in northern Utah and southern Idaho and has completed the research for his M.S. thesis. Data which he has collected concern nesting activity, nesting success, habitat utilization, mortality, food habits and prey biomass determinations.

2. Leon Powers at Idaho State University is collecting data for a doctoral dissertation in the same area as Richard Howard in a cooperative study. His emphasis is on ferruginous hawk behavior, including courtship, incubation, parental care of the young and dispersion of young birds banded and identified with color-coded patagial wing markers.

3. Neil Woffindon at Brigham Young University is studying ferruginous hawk predator-prey relationships in central Utah. He will attempt to establish the quantitative effect of ferruginous hawk predation on its prey species, with emphasis on the black-tailed jackrabbit (Lepus californicus).

10. Authorities

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2. Richard Howard (Idaho-Utah)
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3. Richard Olendorff (northeastern Colorado)
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11. Governmental, Private and International Organizations Actively Involved With This Species' Welfare

A. 1. National Audubon Society
950 Third Avenue
New York, New York 10022

2. The major objective of the National Audubon Society is to advance public understanding of the value and need for conservation of our wildlife, its habitat, and all natural resources, and the relationship of wise use and intelligent treatment to human progress.

3. Alexander Sprunt, IV, Research Director

4. National Audubon has a series of leaflets and charts on birds of prey and has concentrated its efforts for raptors in the area of education and protective legislation.

B. 1. Raptor Research Foundation, Inc.
c/o Department of Biology
University of South Dakota
Vermillion, South Dakota 57069

2. The Raptor Research Foundation is a non-profit corporation whose purpose is to stimulate, coordinate, direct and conduct research in the biology and management of birds of prey, and to promote a better public understanding and appreciation of the value of these birds. A major activity is the publication of Raptor Research, which serves to convey information contributed by researchers on birds of prey.

3. Dr. Byron E. Harrell, President

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